BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE INSTRUCTION 41-203

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Health Services

ELECTRICAL SAFETY IN MEDICAL TREATMENT FACILITIES

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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(Col James P. Moreland)
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This AFI implements AFPD 41-2, *Medical Support*, and provides guidance for electrical safety in the medical treatment environment. It also serves as a central reference for the use of nationally recognized safety standards. This guidance is not intended to be all inclusive, but establishes minimum requirements for electrical safety. Existing standards are emphasized with references provided. This instruction applies to all Air Force Medical Treatment Facilities. Send comments and suggested improvements on AF Form 847, **Recommendation for Change of Publication,** through channels, to HQ USAF/SGML, 110 Luke Avenue, Room 400, Bolling AFB, DC 20332-7050.

SUMMARY OF REVISIONS

This document is substantially revised and must be completely reviewed.

This publication of AFI 41-203 supersedes the previous version of AFI 41-203, dated 25 July 1994. It updates references to AFOSH 91-8 (Formally AFOSH 127-8) and NFPA 99.

Section A—Defining the Electrical Safety Program

1. Program Purpose. The Medical Treatment Facility (MTF) is a unique environment and requires special procedures to ensure the electrical safety of patients and staff. Each facility will establish a proactive electrical safety program that centers around identifying potential hazards, correcting the hazard, testing to ensure the hazard does not recur, and training personnel to identify new and existing hazards.

2. Philosophy. Unless otherwise directed in this instruction, AFI 41-201, *Managing Clinical Engineering Programs*, or in AFOSH 91-8, *Safety: Medical Facilities*, the MTF electrical safety program will adhere to the guidance and standards established by NFPA 99, *Health Care Facilities;* NFPA 101, *Life Safety Code;* and NFPA 70, *National Electrical Code***.**

3. Responsibilities.

3.1. MTF Commander and Medical Support Squadron Commander will:

3.1.1. Ensure both implementation of the electrical safety program and close coordination between functional areas.

3.1.2. Identify and document designations of general care, critical care, anesthetizing, and wet locations within the MTF.

3.1.3. Ensure adequacy of the Electrical Safety Program and its inclusion in the local training programs.

3.1.4. Review actions of the Environment of Care Committee.

3.1.5. Approve local electrical safety procedures established to satisfy special or unique safety requirements.

3.1.6. Approve policy and procedures for the use of privately owned, line-powered electrical devices.

3.2. Facility Management will:

3.2.1. Maintain the overall safety program for entire MTF.

3.2.2. Ensure the identification and correction of electrical safety hazards.

3.2.3. Coordinate with Real Property maintainers (Base Civil Engineer (BCE) or preventative maintenance contractor) to ensure their inspections of the power distribution and emergency power systems are performed and documented IAW Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Environment of Care Standards 1.7 and 2.10.4.

3.2.4. Coordinate with Real Property maintainers for the correction of power distribution system hazards identified through inspection.

3.3. Medical Maintenance will:

3.3.1. Maintain all medical equipment.

3.3.2. Maintain oversight responsibility for the safe use of electrical devices in patient care areas.

3.3.3. Perform required electrical safety inspections of all medical equipment used in the MTF and nonmedical equipment used in patient care areas as outlined in this AFI and AFI 41-201.

3.3.4. Perform required testing of isolated power systems and ground fault circuit interrupters (GFCIs).

3.3.5. Assist the Chief of the Medical Staff and others responsible for in-service training by providing user education on electrical safety.

3.3.6. Ensure equipment proposed for purchase is compatible with existing equipment and utility systems.

3.3.7. Maintain documentation of medical equipment safety testing and a file of service and operating literature as outlined in AFI 41-201. Documentation may be maintained in electronic file formats.

3.4. Medical Materiel and Medical Equipment Management Offices will:

3.4.1. Coordinate with Medical Maintenance and Facilities Management to ensure the acquisition of equipment and supplies which comply with the electrical safety standards outlined in this AFI.

3.4.2. Ensure contracts reflect the requirements of AFI 41-201, NFPA 99 Chapter 7-6.2.1.7 "Specifications of Conditions of Purchase," and 7-6.2.1.8 "Manuals for Appliances".

3.5. MTF Environment of Care Committee will:

3.5.1. Review and oversee MTF safety programs.

3.5.2. Review actions taken by Real Property maintainers, MTF Safety Officer, Medical Maintenance, and Facility Management regarding the inspection, testing, and documentation of MTF electrical equipment, power systems, and ground distribution systems.

3.5.3. Review and recommend to the MTF Commander or Medical Support Squadron Commander local electrical safety actions and procedures.

3.6. Chief of the Medical Staff, In-Service Education Coordinators, Squadron Commanders, and Department Chiefs will:

3.6.1. Provide training on electrical safety and the safe operation of medical equipment.

3.6.2. Ensure adequate awareness for electrical safety is provided through safety briefings and training.

3.6.3. Ensure electrical safety training is documented.

3.7. Real Property Maintainers (BCE or Preventive Maintenance Contractor) will:

3.7.1. Provide engineering support for the installation, maintenance, and testing of MTF power distribution systems.

3.7.2. Conduct inspections and evaluations of the electrical distribution system required by NFPA 99 and this AFI.

3.7.3. Perform required testing of the grounding system integrity and electrical receptacles required by NFPA 99 and this AFI.

3.7.4. Provide written analysis, including actions both required and taken, of electrical distribution system inspections and evaluations.

3.8. Equipment Users and Staff will:

3.8.1. Implement the electrical safety program.

3.8.2. Observe safe practices for using electrically operated equipment, particularly in the presence of patients subject to invasive procedures.

3.8.3. Ensure equipment is visually inspected for electrical hazards and known problems are corrected before equipment is placed in use.

3.8.4. Ensure identified hazards are reported using locally established procedures.

Section B—Program Operation

4. Training the Staff.

4.1. The fundamental element of the MTF electrical safety program is safe equipment operation. Only when the MTF staff becomes consciously aware and alert to practices which constitute "good electrical hygiene" will the hazards of electrical shock be acceptably minimized. JCAHO standards require safety training as part of staff orientation and annual refresher training to ensure safe use of equipment.

4.2. Training is the responsibility of the area supervisors and incorporates the following:

4.2.1. Orientations. Include procedures for reporting safety hazards, points of contact for corrections, accident reporting and investigation procedures, hazards unique to their work area, and equipment in-service training.

4.2.2. Equipment In-Service Training. Include safe operation and user maintenance. Each staff member must understand how to visually inspect equipment for potential hazards.

4.2.3. Electrical Safety Briefings. Include as a minimum: program changes, the results of Environment of Care Committee's findings from the organizations safety program, and periodic training in fire suppression. Additional guidance is found in NFPA 99 Chapter 7-6.5 "Qualification and Training of Personnel".

4.2.4. Documentation. All training (user/operator, safety, etc.) must be appropriately documented.

4.3. Medical Maintenance will provide electrical safety training when requested by the area supervisor. MTFs may also consult Medical Equipment Repair Centers for additional guidance in developing safety training programs.

4.4. Additional training material can be found in NFPA 99, Appendix A-3-2.2.2, "Shock Prevention" or through other agencies and references listed in **Attachment 1**.

5. Extension Cords, Power Strips, Surge Protectors, and Adapters.

5.1. The use of electrical extension cords will be minimized in patient care areas. Extension cords will be used only as temporary measures. The MTF's Safety Officer must verify the need for all extension cords and grant approval in writing before they may be used. If extension cords are necessary, they will be heavy duty, three-conductor cords with hospital grade connectors and meet requirements of NFPA 99, Chapters 7, 9 and 12. Extension cords must be approved, *as an assembly*, by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters' Laboratory (UL) [Reference 29 CFR 1910.303(a) and 29 CFR 1926.403(a)]. When an extension cord is used in patient care areas to place medical equipment into operation, an electrical safety inspection must be performed with the cord in the circuit. When an extension cord is used for the purpose of placing medical equipment into operation for an extended period, Medical Maintenance will initiate a facility work order to have an adequate receptacle (and branch, if needed) installed to eliminate the need for a permanent extension cord. Ungrounded (two-wire) extension cords are prohibited. Metallic-bodied two or three-blade end connectors are also prohibited. Extension cords shall not be connected to lighting fixtures in anesthetizing locations under any circumstances [Reference NFPA 99, 12-4.1.2.5(b)]. Extension cords of any type are prohibited in areas where flammables are used or stored (see NEC Article 517 and Federal Specification W-C-596).

5.2. Extension cords must be suitable for use, sized to support the expected load (but no smaller than #16 AWG) and conform to manufacturer requirements for power cords and attachment plugs as defined in NFPA 99, Chapter 9-2.1.2.

5.3. Three-to-two-prong adapters are prohibited per NFPA 99, Chapter 7-6.2.1.5, "Adapters and Extension Cords". However, BMETs may use the three-to-two-prong adapters ("cheater adapter") when necessary to facilitate testing and repair of medical equipment.

5.4. Power Strips:

5.4.1. A power strip is a UL approved conductor cord with built-in fuse or circuit breaker, multiple outlets, and with an amperage rating of 15 or less amps. Power strips will not exceed 15 feet in total length. The MTF Safety Officer must approve use of power strips, with non-medical equipment. Medical Maintenance must evaluate and approve power strips used with medical equipment.

5.4.2. The maximum amperage rating of the power strip must never be less that of the appliance cord rating or exceed the electrical rating of the outlets.

5.4.3. Power strips can be used to extend power from the wall outlet to power low amperage computers and office equipment.

5.4.4. Power strips will not be plugged into another power strip or extension cord.

5.5. A surge protector is a device with built in components to protect equipment connected to it from excessive energy by shorting this energy to ground. Normally, they are configured as a power strip, but may be configured as a single or multiple outlet adapter that plugs directly into a wall outlet. (Most have an indicator light identifying them as surge protectors). Surge protectors will not be connected to patient care equipment unless required by the manufacturer.

5.6. At a minimum, extension cords, power strips, and surge protectors must be inspected annually by the Section Safety Monitor.

6. Use of Privately Owned Equipment.

6.1. Patient Owned:

6.1.1. Restrict use of patient-owned electrical devices to those necessary for the welfare of the patient and appropriate for the patient care environment.

6.1.2. Develop local written procedures to control the use of patient-owned electrical devices in patient care environments. These procedures ensure:

6.1.2.1. Visual safety inspection of the device by trained personnel. Note: Personnel performing inspections are trained by Medical Maintenance personnel on local safety inspection procedures.

6.1.2.2. Approval by a medical practitioner who has established that the patient is mentally and physically able to use the device safely.

6.1.2.3. Inspection and approval of the device is documented according to local policies.

6.2. Staff Owned:

6.2.1. Staff-owned medical electrical devices must conform to the same requirements of MTF-owned medical equipment and must be inspected by the BMET prior to use in the facility. See AFI 41-201, NFPA 99, 7-6.2.1.11, and the local Equipment Management Plan.

6.2.2. Staff-owned nonmedical electrical devices used in patient care areas are subject to the same safety requirements as MTF-owned devices and should be used with discretion.

6.2.3. Staff members file, and retain at the MTF, equipment inspection and maintenance documentation.

6.3. Consult Medical Maintenance personnel when the safety of a device is questionable.

Section C—Program Requirements

7. Administrative Tasks.

7.1. Classification of Areas.

7.1.1. Medical Maintenance is responsible for the classification of all patient care areas of the MTF as general care, critical care, and wet locations. Wet locations can be areas within general and critical care areas.

7.1.2. The MTF Commander or his designee approves the designation of these areas in writing and provides this information to functional areas involved with maintaining electrical safety.

7.1.3. Designate anesthetizing locations to include areas of conscious sedation.

7.1.4. Definitions for classification can be found in **Attachment 1**, or NFPA 99, Chapter 2.

7.1.5. Source of requirement: NFPA 99, Chapter 12-2.6., “Patient Care Areas.”

7.2. Documentation.

7.2.1. Facility Management is responsible for ensuring the maintenance of records of tests, performance test results, exercising periods and associated repairs and modifications for all normal electrical distribution systems, essential power distribution systems, and isolated power systems.

7.2.2. Source of requirement: NFPA 99, Chapter 3-3.4.3., "Recordkeeping."

7.3. Literature File.

7.3.1. Medical Maintenance will maintain an accessible permanent file of operating instructions and maintenance manuals for all patient care devices.

7.3.2. Source of requirement: NFPA 99, Chapter 7-6.3.1.1, "Instruction Manuals."

8. Electrical Systems Testing.

8.1. Testing the Grounding Systems in Patient Care Areas.

8.1.1. Testing the grounding systems in patient care areas is the responsibility of Real Property Maintainers, reference AFI 32-1065, *Grounding Systems*.

8.1.2. Test the effectiveness of the grounding system for new construction, and after any alteration or replacement of an existing power distribution system.

8.1.3. Source of requirement: NFPA 99, Chapter 3-3.3.2, "Grounding System in Patient Care Areas."

8.2. Testing the Receptacles in Patient Care Areas.

8.2.1. Testing the receptacles is the responsibility of the Real Property Maintainer.

8.2.2. Test receptacles in patient care areas for physical integrity, continuity, polarity, and retention force after initial installation, replacement, or servicing.

8.2.3. Additional testing of hospital-grade receptacles shall be performed at intervals defined by documented performance data.

8.2.4. Receptacles not listed as hospital-grade shall be tested at intervals not exceeding 12 months.

8.2.5. When testing is conducted, all receptacles in patient care areas are to be tested.

8.2.6. Source of requirement: NFPA 99, Chapter 3-3.3.3., "Receptacle Testing in Patient Care Areas", and 3-3.4.2.3(4) "Testing Interval for Receptacles in Patient Care Areas."

8.2.7. Additional Information: Reference AFI 32-1065.

NOTE: NEC Article 517 specifies that all patient bed location receptacles shall be listed “hospital-grade” and so identified.

NOTE: Mil-Handbook-1191 specifies that Tamperproof safety receptacles will be provided in all medical areas occupied by unattended children, including playrooms, baths, toilets, pediatric waiting and pediatric bedrooms. Safety receptacles will be provided in psychiatric seclusion rooms.

8.3. Testing the Ground Fault Circuit Interrupters (GFCIs) in patient care areas.

8.3.1. Testing the GFCIs is the responsibility of Medical Maintenance. When possible, Medical Maintenance should establish an agreement with the MTF’s Real Property Maintainer to perform this operation during the test of the receptacles in accordance with NFPA 99, A-3-3.2.1.2(a)4a & b and A-3-3.2.1.2(e)3(f).

8.3.2. Test GFCIs by momentarily connecting a device or component to flow 6 milliampere (ma) of current between ground and the energized conductor of power distribution circuit. Verify that the GFCI does interrupt the power.

8.3.3. Test function of GFCIs in patient care areas after initial installation, replacement, or servicing of the device. Perform additional testing in accordance with the current edition of NFPA 99.

8.4. Testing the isolated power systems and line isolation monitors (LIM).

8.4.1. Testing the isolated power systems and LIM is the responsibility of Medical Maintenance. See AFI 41-201.

8.4.2. Test the function of each LIM circuit on a regular interval as defined in NFPA 99. Actuate the LIM test switch or ground each circuit through a resistive load as indicated by the interval. (Note: NFPA 99 requires that the LIM test switch be activated on a monthly basis and the circuit be tested through a resistive load every 6 months.)

8.4.3. Test the function of each LIM circuit by actuating the LIM test switch and by grounding each circuit through a resistive load after installation, repair, or renovation.

8.4.4. Source of requirement: NFPA 99 Chapter 3-3.3.4 "Isolated Power Systems."

8.5. Testing of Alternate Power Sources and Transfer Switches.

8.5.1. Testing alternate power sources and transfer switches are the responsibility of Facilities Management and Real Property Maintainer.

8.5.2. Test alternate power sources, as defined by NFPA, under load and from a complete simulated cold start. (Note: The 1999 edition of NFPA 99 requires testing of units at intervals of not less than 20 days or exceeding 40 days. The minimum engine runtime is 30 minutes at a load of 30 percent of the nameplate rating of the generator. Facilities that do not meet the 30 percent requirement must ensure that the exhaust temperatures meet manufacturer's specifications.)

8.5.3. Source of requirement: NFPA 99 Chapter 3.

8.5.4. Additional Information: NFPA 99 includes a requirement to test the transfer switches, generator sets, circuit breakers and storage batteries.

9. Equipment Testing.

9.1. Chapters 7 and 9 of the NFPA 99 contain information and procedures for testing medical equipment. The testing intervals for all Air Force medical equipment are provided in AFI 41-201. Use the NFPA recommended interval only if there is no comparable equipment listed or when the equipment is located in a wet location or critical-care location. Electrical safety test instruments must be tested for acceptable performance at least annually.

9.2. Test battery-operated devices that are usable when connected to line power using the same requirements of line-operated devices.

9.3. Electrical Safety Inspections of Medical Equipment Used in Patient Care Areas.

9.3.1. Electrical safety inspections of medical equipment used in patient care areas is the responsibility of Medical Maintenance.

9.3.2. Safety inspections include visual inspection of the unit, physical integrity of power cords and strain reliefs, and other appropriate tests defined in this AFI.

9.3.3. Establish local guidance, when appropriate, for the testing of ground pin to chassis resistance on portable equipment with detachable power cords.

9.3.4. All electrical safety inspection results, to include leakage current measurements, must be documented on scheduled workorders. Unscheduled workorders must include electrical safety results when system integrity is compromised.

9.3.5. Source of requirement: AFI 41-201 and NFPA 99 Chapter 7-6.2.1.2 "Testing Intervals". Note**:** NFPA 99 requires testing of all patient-care-related electrical requirements at intervals not exceeding 12 months for general care areas, and not exceeding 6 months for critical care areas and wet locations. See NFPA 99: 7-6.2.1.2(b) for exceptions.

9.4. Resistance and Leakage Current Tests.

9.4.1. Resistance and leakage current tests are the responsibility of Medical Maintenance.

9.4.2. Perform resistance and chassis leakage current tests during initial equipment inspection, after equipment has been repaired or modified, and during scheduled preventative maintenance inspections.

9.4.3. Source of requirement: AFI 41-201 and NFPA 99, Chapter 7-6.2.1.2, "Testing Intervals" and Chapter 7-5.1.3 "Testing Requirements."

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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFPD 41-2, Medical Support

AFI 41-201, Managing Clinical Engineering Programs

AFI 32-1065, Grounding Systems

AFI 91-202, The USAF Mishap Prevention Program

AFOSH 91-8, Medical Facilities

NFPA 99, Health Care Facilities

NFPA 101, Life Safety Code

NFPA 70, National Electrical Code

NFPA 70 (NEC) Article 517 "Health Care Facilities"

Abbreviations and Acronyms

AFI—Air Force Instruction

AFMLL—Air Force Medical Logistics Letter

AFMLO—Air Force Medical Logistics Office

AFOSH—Air Force Occupational Safety and Health

AFPD—Air Force Policy Directive

AWG—American Wire Gauge

BCE—Base Civil Engineer

BMET—Biomedical Engineering Technician

GFCI—Groundfault Circuit Interrupter

JCAHO—Joint Commission on Accreditation of Healthcare Organizations

LIM—Line Isolation Monitor

MERC—Medical Equipment Repair Center

MTF—Medical Treatment Facility

NEC—National Electrical Code (NFPA 70)

NFPA—National Fire Protection Association

Terms

Critical Care Areas—Special care units, intensive care units, coronary care units, angiography laboratories, cardiac catheterization laboratories, delivery rooms, operating rooms, and similar areas in

which patients are subject to invasive procedures and connected to line-operated, electromedical devices.

General Care Areas—Patient bedrooms, examining rooms, treatment rooms, clinics, and similar areas in which the patient is in contact with ordinary appliances such as nurse-call systems, electric beds, examining lamps, telephones, and entertainment devices. (Note: In such areas, patients may be connected to electromedical devices such as heating pads, electrocardiographs, drainage pumps, monitors, otoscopes, ophthalmoscopes, intravenous lines, etc.).

Patient Care Area—Any portion of a health care facility wherein patients are intended to be examined or treated. (Note: Business offices, corridors, lounges, day rooms, dining rooms, or similar areas are not typically classified as patient care areas.)

Wet Locations—A patient care area that is "normally" subject to wet conditions while patients are present. This includes standing fluids on the floor or drenching of the work area, either of which condition is intimate to the patient or staff. Routine housekeeping procedures and incidental spillage of liquids do not define a wet location.

Additional definitions and terms can be found in NFPA 99, Chapter 2.

Additional Sources of Information

- National Fire Protection Association (NFPA) codes and pamphlets. NFPA, Publication Orders, One Batterymarch Park, Quincy MA 02269 (800) 344-3555; **http://www.nfpa.org**;
email: **mailto:custserv@nfpa.org**.

- Joint Commission Manuals. Joint Commission on Accreditation of Healthcare Organizations, One Renaissance Boulevard, Oakbroook Terrace IL 60181, (630) 792-5800; **http://www.jcaho.org**

- ECRI documentation. ECRI, 5200 Butler Pike, Plymouth Meeting PA, 19462-1298, (610) 834-1275; **http://www.ecri.org**; email: **mailto:info@ecri.org**.